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ABSTRACTS

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DS-10. Investigation of magnetic and thermal properties of the Bio-plasma treated $Ni_{1-x}Zn_xFe_2O_4$ based on Mössbauer spectroscopy.

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The $Ni_{1-x}Zn_xFe_2O_4$ (x = 0, 0.25, 0.50, 0.75, 1.0) nanoparticles (NPs) were prepared by high temperature thermal decomposition method. From the XRD patterns analyzed by Rietveld refinement, the crystal structure was confirmed to be cubic spinel structure with space group *Fd*-3m. The lattice constant (a_0) increased from 8.3431 Å to 8.4274 ± 0.0001 Å with increasing Zn concentration. The thermal properties of all samples were measured by magneTherm device at 112 kHz and 250 Oe. The self-heating temperature of the samples was determined as the highest temperature measured in $Ni_{0.25}Zn_{0.75}Fe_2O_4$ NPs. In order to investigate the magnetic properties of the samples, the NPs were measured by vibrating sample magnetometer (VSM). The VSM measurements showed that the saturation magnetization (M_s) of sample for x=0.75 was 56.22emu/g, which is the highest among the samples studied. Since $Ni_{0.25}Zn_{0.75}Fe_2O_4$ has high magnetization and self-heating temperature, this sample was further treated with atmospheric pressure bio-plasma for 30 min under argon gas, which enhanced the magnetization and self-heating temperature. $Ni_{0.25}Zn_{0.75}Fe_2O_4$ before and after bio-plasma treatment were measured using Mössbauer spectroscopy from 4.2 to 295 K. We have fitted the Mössbauer spectra based on the random distribution of Fe and Zn ions on the tetrahedral A-site. The probability for the octahedral B-site having nearest-neighboring Zn atoms was estimated with the binomial distribution. In this way, the spectra were analyzed with six-sextets while varying *n* and *a*, and *P(n, a)* exceeded 5%. Also, we have performed the Mössbauer measurements with high external field of 5 T at various temperatures and the spin canting angles of $Ni_{0.25}Zn_{0.75}Fe_2O_4$ NPs before and after bio-plasma treatment were determined. The experimentally observed increase in the canting angle can be associated with increasing internal magnetic energy. Our research suggests that the bio-plasma treatment affects the magnetic and thermal properties of nanoparticles for hyperthermia applications. We expect bio-plasma treated NPs to be increased magnetic, thermal properties by from the conversion of the internal magnetic energy to thermal energy.

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DS-11. The crystalline, magnetic and dielectric properties of Zn doped strontium Z-type hexaferrite synthesized by polymerizable complex method.

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It is known that $Sr_3Co_2Fe_{24}O_{41}$ Z-type hexaferrite is most difficult to prepare as a single-phase because the temperature range for the formation of Z-type ferrite is narrow. Therefore, the polycrystalline samples of $Sr_3Co_{2-x}Zn_xFe_{24}O_{41}$ (x = 0.0, 0.5, 1.0, 1.5, 2.0) were synthesized by the polymerizable complex method. The polymerizable complex method is based on the formation of metal-organic complexes and subsequent polyesterification as well as sintering at lower temperature than formation temperature of Z-type ferrite. The crystallographic, magnetic and dielectric properties of samples were investigated by using x-ray diffractometer (XRD), Fe-SEM, vibrating sample magnetometer (VSM), Mössbauer spectroscopy and network analyzer. From the analyzed XRD patterns by Rietveld refinement, all samples were determined to be single-phased, and the crystal structure of $Sr_3Co_{2-x}Zn_xFe_{24}O_{41}$ (x = 0.0, 0.5, 1.0, 1.5, 2.0) samples was confirmed to be hexagonal structure with the space group *P6₃/mmc*. The lattice constant a_0 and c_0 increased from a_0 = 5.86, c_0 = 51.91 for x = 0.0 to a_0 = 5.87, c_0 = 51.98 Å for x = 2.0, because Fe^{3+} ions are transferred from tetrahedral sites to octahedral sites. The hysteresis curves under 15 kOe at 4.2 and 295 K indicated that all samples were not saturated due to the high planar anisotropy of Sr ions. In additon, coercivity (H_c) of samples decreased with increasing Zn ions contents. From the temperature dependence of the magnetization curves under 100 Oe between 4.2 and 800 K, the Curie temperature (T_C) of samples decreased with increasing Zn ions contents. To investigate the hyperfine interaction and ions distribution, zero-field Mössbauer spectra of all samples were obtained at various temperatures ranging from 4.2 to 800 K, and least-squares fitted with the spectra below T_C as six distinguishable sextets ($4f_{IV}$, $4f_{IV}^*$, $12k_{VI}^*$, $4f_{VI}^*$+ $4e_{IV}$, $12k_{VI}$, and $2d_V + 2a_{VI} + 4f_{VI} + 4e_{VI}$) due to the superposition of ten-sextets for Fe sites corresponding to Z-type hexaferrite. Isomer shift values of all samples indicates that the iron ions have Fe^{3+}. Complex permeability (μ) and permittivity (ε*)* of all samples were measured between 100 MHz to 4 GHz.

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DS-12. The ferromagnetic resonance linewidth of thin La:YIG films prepared by liquid phase epitaxy method.

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$Y_3Fe_5O_{12}$ (YIG) is an ideal conductor for spin-wave spin currents even though it is an insulator for electric currents [1], which provide real applications in spintronic field [1-5]. Until now, only YIG single crystal films have been used because of its extremely small damping and excellent electrically insulating behavior. Therefore, high quality YIG films with sub-micrometer thickness are in urgent demand. Although pulse laser deposition (PLD) and sputtering methods have been demonstrated to fabricate YIG films with nanometer thickness [6], LPE is believed to be the best technique for growing ultrathin single-crystal YIG films. However, with LPE technique, it is very difficult to obtain thin YIG film with very narrow FMR line-width because of the existence of "transient layer" between the film and substrate [7]. In this transient layer, ions with segregation coefficients less than 1.0, for instance, lead and lanthanum, are sharply higher than in the bulk, resulting in a very large FMR linewidth. In our experiment, $Y_{3-x}La_xFe_5O_{12}$ (La:YIG) films with thickness of 130nm to 800nm were fabricated on GGG(111) substrates at different growth conditions by LPE method. High quality ultrathin films with low defects and mirror surface have been successfully obtained, with a typical FMR linewidth ΔH≤2.0Oe near 9.0GHz and a damping constant $\alpha \le 1.2*10^{-4}$. Interestingly, we found that the ultrathin film grown at lower temperature and higher super-cooling has narrower FMR line-width. This result is ambivalent with that observed in thick La:YIG film [8]. To clarify this contradiction, we develop a growth model for LPE grown YIG film. We notice that the growth mechanisms for thin and thick films are different thus different growth model should be applied. For thick film, the resistor from dispersion dominates in the growing process, while for thin garnet film it is the resistor from interface plays an important role. The thin film grown from high super-cooling has bigger growth driving force and rougher interface, which promote the growth from interface to steady-state quickly, leading to thinner transient layer as well as the narrow FMR linewidth.

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DS-13. Effect of Thickness on Magnetic and Microwave Properties of RF-Sputtered Zn-Ferrite Thin Films.

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Zinc ferrite ($ZnFe_2O_4$) thin films show excellent magnetic and ferromagnetic resonance (FMR) properties, even without depositing or treating them at high temperatures. However, the magnetic properties of these films depend strongly on the microstructure and the preparation conditions [1-3]. In this